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HAILSTORM AT OBER GRAINAU, BAVARIA, 4TH JUNE, 1882.

[AS many of our readers are aware, Col. Ward, F.R.A.S., F.M.S., has for some time been devoting considerable attention to the forms of hail which fall in different parts of Bavaria, and we are indebted to him for the following very interesting and carefully prepared account and illustrations.—ED. *Met. Mag.*]

OBER GRAINAU, is four miles W. of Partenkirchen,* Bavaria, 2752 ft. above sea level, and at the northern base of Zugspitz (9760 ft.).

From 23rd to 31st May, fine hot weather, with continual TSS on mountains; first three days of June very fine.

Morning of June 4th hot; sun burning; air full of electricity. Temperature, 72°·0; after storm, 68°·0. Barometer steady at 27·600 in., as shown by registering aneroid. General direction of wind, as indicated by cir. and cir-c, S.W.; N.N.E. breeze down the valley, as usual in fine weather.

We started for the Eib See about 2.30 p.m. About 3.30 heavy TS in S. and S.E. A second came up from S.W. behind Daniel or Ups Spitz; loud thunder; no L visible; apparently very heavy rain falling. After passing the peak of the Daniel the storm divided, one part passing towards S. and E. over the Zugspitz, and along the Wetterstein range; the other and heavier part going N. and towards E. along the ridge of the Kramer Berg, the two parts being connected by a band of dark gray pocky-looking cloud, having a flat under surface, beneath which blue sky and mountains over the Plan See were visible.

From the S. portion of the divided storm, a considerable fragment of cloud seemed to detach itself, and to travel down the valley, following the course of the River Loisach, till it joined the band of cloud; it was very white, and rain or hail fell from it during its course. At ten minutes to 4 a long loud peal of thunder rolled along this band of

* Partenkirchen is in Lat. 47° 28′ N., and Lon. 11° 5′ E., and 2,269 ft. above sea level.

cloud, followed by a loud roaring, which at first seemed like a continuation of the peal, and the whole valley was filled with falling matter, which on approaching looked like immense drops of rain, but were, as it afterwards proved, large hailstones. The noise sounded as if a lake had burst, and was rushing down the valley, and our first thought was, Has the Eibsee burst? We hurried to an eminence to get a better view, the roaring increased, and we had barely reached the shelter of a châlet when a few immense drops of rain, like half-crowns, fell, and here and there a huge pure white hail-stone, which bounded high into the air on reaching the ground. In a moment (4 p.m.) these became general, and fell incessantly, without any rain, thunder, or lightning, for seven or eight minutes, covering the ground. Cattle were running everywhere down the hill sides for shelter; twigs and branches were torn off by the hail, the stems of some being three-eights of an inch in diameter; the stones rebounded from the ground on to the roofs of the châlets, the eaves of which were 16 ft. from the ground; wooden tiles (new) were knocked off the châlet under which we were sheltering ourselves; these as they lay upon the ground being split in two by other hailstones, the latter themselves being shivered into small fragments if they chanced to fall on a rock or stone.

It was most curious to see these small snowballs, as they appeared to be, striking the hill slopes, and flying high into the air, to descend a second time, and roll down to collect in masses in the hollows.

The storm ceased as suddenly as it began, a few large stones falling here and there, a gentle light rain (more mist than rain) falling for a few moments; the sun then came out, and at 4.15 all was passed away, the cloud gradually dissolving, as it travelled towards the S.E. leaving only the two main storms N. and S. over the Kramer and Wetterstein ranges respectively.

Only a slight wind accompanied the storm; the hailstones did not vary much in size throughout, the average size being $1\frac{1}{4}$ inches, few less than $\frac{3}{4}$ inch in diameter; the largest, No. 4 in sketch, being two inches long by $1\frac{1}{2}$ wide, $1\frac{1}{4}$ thick, and, as far as could be judged, 2 oz. in weight. Larger ones must, we think, have fallen, as on the way home, more than an hour after the storm, No. 2 stone was picked up, and it was then $1\frac{1}{4}$ inches each way.

By the Bader See the ground was strewed with branches, and though the ground was covered with large hailstones, there was no trace of them in the lake, which is of the clearest green water, apparently a foot deep, but in reality many feet, and in some places sixty or more. At Unter Grainau, about a mile N. from Ober Grainau, and separated from the river Loisach by a wooded ridge, the stones were much smaller, though of the same shape and character. From Ober Grainau to the Eib See the stones were of the same size. At both places the natives had taken the precaution of shutting their outer shutters, otherwise not a window would have escaped. They were much amused at the interest we took in the storm, and at our making

measurements and sketches of the stones; they say these curious shapes are by no means uncommon, nor are such storms, though it is three years since they had one with such large hailstones, and on that occasion the storm lasted much longer, the hail being ancle deep, and in many places, on the adjoining hills, over the knees in depth.

From the spot marked ⊕ in the map (where No. 2 stone was picked up), to the spot marked ✕ near Garmisch, there was comparatively little hail, and none of the large size; but here again it increased in quantity, and we found on arrival at Partenkirchen that there had been a severe hailstorm lasting for about ten minutes, and later by more than half-an-hour than that at Grainau.

This storm evidently proceeded from the N. portion of the original TS, which passed along the Kramer range, and crossed the valley running N.E. to the plain and Munich. It came from N.N.E. with a very strong wind the main TS passing over the Eckenberg N.E. of Partenkirchen to the eastward. The hailstorm travelled S. towards the Wetterstein range, to about the same spot where the Grainau storm disappeared. The hailstones were not so large as those at Grainau, but were of the same form and character, their average size being three-quarters of an inch diameter, the largest one three-quarter inch; several being of the size of peas only. When cut across they shewed concentric rings like those at Grainau. Two hours after the storms had passed, the hailstones were still lying in the open.

The general form of the hailstones was round or oval, the latter were generally in two parts joined together like a walnut shell.

Some were opaque like porcelain, others semi-transparent with a nucleus and not a few perfectly transparent and clear.

Two, opaque and transparent, melted in the hand, retained their opacity and transparency respectively to the last.

Subjoined is a description of a few of the stones, the shape of some being most extraordinary. A map of the country shewing the course of the two storms is also added *(see frontispiece)*, on which the courses of the storms are marked in red. The heavy black lines indicate the general direction of the mountain ridges.

MICHAEL FOSTER WARD, F.M.S., F.R.A.S.
SEYMOUR J. G. EGERTON.
ROBT. THOS. JACKSON.
SAMUEL SPACKMAN.

Although the hail appeared to be falling so thickly, Mr. Egerton, who was some seventy yards from the rest of the party, said that not more than seven or eight stones struck his umbrella on his way to rejoin them.

DESCRIPTION OF HAILSTONES. *(See next page.)*

No. 1.—Like a snail's head. Nucleus at *a*. Perfectly transparent from *b*. At *c* a depression, looking as if a point, similar to that on the other horn, had been knocked off.

Nos. 2 and 3.—Irregular and opaque masses of ice (like the majority of the stones), the protuberances transparent and in No. 3 detached.

No. 4.—Somewhat like a glass scent bottle—the centre opaque and depressed, with a smooth surface. Surface of stone covered with innumerable small lumps, varying in size, and looking like boiled sago. When cut lengthways on line A B, rays were found running from the nucleus to the ends. The two sides seemed joined like a walnut.

No. 5.—Centre opaque; outer part transparent, with faint short rays from nucleus.

Nos. 6 and 7.—Like comets. Nucleus pure white and rather soft; the rings (*a b c*) opaque, and divided by thin transparent lines; *d* semi-transparent; *e* clear as crystal.

Nos. 8 and 9.—Round and pear-shaped opaque stones.

No. 10.—Section of 8 and 9, shewing concentric rings, five in number, like the section of a radish, or the stem of a tree cut across; each ring increasing in width from nucleus, the outer ring almost transparent.

Nos. 2, 3, 4, 5, 8 and 9 very numerous, and not a few of No. 8 perfectly transparent, with slight rays from centre; no real nucleus.

No. 4 was the largest picked up of that form. It was 2 inches long, $1\frac{1}{2}$ wide, and $1\frac{1}{4}$ thick, and weighed at least 2 oz.

It must be understood that all the drawings are as near as may be two-thirds of the actual size of the stones.

THE RECENT AURORÆ.

THE periodicity of auroræ has been long recognised, and Prof. Piazzi Smyth, the Astronomer Royal for Scotland, has recently described how, upon two strangers calling on him for meteorological information, he pointed out to them on his chart the auroral curve rising high towards the end of 1882. Accordingly, the last month (November) has witnessed a grand outbreak of these phenomena.

The accounts are probably not yet all published, but judging from what we have received, this display, or rather series of displays, extended at least from the 13th to the 24th of the month, and during this period not only were they seen when the nights were fine and clear, but cloudy nights showed an auroral glow, while the perturbations of the magnetic needle indicated that the displays, though invisible to us, were going on during each day.

The papers and scientific prints have teemed with reports, including two from the observatories at Greenwich and Edinburgh (the display in the latter case marred sadly by the smoke of Auld Reekie); from Leeds, Bristol, York, Bedford, Cirencester, Huntingdon, Windsor, and a host of places, with more or less graphic descriptions of what was seen. It is not easy to analyse these, but the accounts generally tend to show that the auroræ were earlier, and

of a more brilliant description, consisting of arches, glows, streamers, and beams in the north; and later both as to coming and leaving in the south, where they were more quiescent with much glow, and not so much of the moving streamers and arches. The descriptions, however, vary much. Hardly two are at all alike, but among them arches, beams, rays, glows, and in fact all the auroral phenomena (except the formation of the corona, of which we have seen no account) take a part. Perhaps the most interesting among these phenomena occurred about 6 p.m. on the 17th, when a bright beam of white-green light formed in the E., rose and drifted in about two minutes across the S. near the moon (then in declination 10° 35′ 28″ S) and sank in the W. It was to many a startling and almost awe-inspiring sight to see this brilliant mass of cloud-light, some 20° long and 3° broad passing along the heavens.

Some observers have assigned, in the *Times* and elsewhere, to this beam the name and character of a meteor, but it is as well to record that it was truly part of the aurora, as proved by a published observation, that it presented the auroral and not a meteoric spectrum. This point is the more important, owing to the "beam" being likely to prove of use in determining the height of the aurora, as it was seen to pass above, across or below the moon, according to the observer's station.

At the Southern and Eastern stations it passed above the moon; at the North and West below; and at intermediate stations across.

Different writers to "Nature" assign to this beam the varying heights of 44, 170, 200 and 212 miles, but as Messrs. De la Rue and Müller's vacuum experiments affirm that at 124 miles, no discharge could pass, the character of the aurora as an electric discharge in air, will apparently require further investigation and elucidation. It is unfortunate that, owing to the moonlight, the recent displays have not added much to our knowledge of the auroral spectrum. The yellow green (Prof. Piazzi Smyth's "citron" line) was seen universally. The red line occasionally, and faintly. The other lines either not at all, or else so vaguely as to render measures impracticable.

However, many observers have specially noted the brilliant green tint and phosphorescent appearance in the displays, which strongly suggest that the aurora, with its absence of recognized air spectrum and lines not far out of position with the bands of phosphoretted hydrogen, may be some form of phosphorescence excited by the polar electric discharges.

Our notice must also include sunspots and earth currents. The sunspots (according to Mr. Rodwell) have been abundant, and of considerable size since August last. During the recent auroræ a grand one has been observed. This was the largest one photographed at Greenwich, according to Mr. Brodie, measuring 56,000 miles by 51,000, and estimated by Capt. Noble to contain 2,000,000,000 square miles of surface. Very noticeable, too, has been the activity

of these spots or solar storms. The large one was observed to change its details in a few hours, and between 4 o'clock one afternoon and 10 the next morning, the umbræ had quite altered in shape. Smaller spots have also been in abundance, and mostly have shewn considerable signs of activity. But again, as to these, the low altitude of the sun prevented such observations of the changes in minute detail of the surface as might have been desirable. Enough, however, was seen to show the great solar disturbance which was taking place. With regard to the earth currents, the public journals have contained many and almost marvellous accounts of the trouble and difficulty experienced in working the State telegraphic communications during the auroral epoch.

In some cases the wires were so highly charged that all ordinary working was temporarily set aside. These charges were not intense (no sparks or shocks are recorded), but had the effect of gradually drawing the needle aside to some 45° from the vertical, where it would remain, and then go back to the same angle on the other side, showing that a succession of positive and negative currents was flowing. The difficulty of working is got over in these cases by partly revolving the needle card with its studs, and working the needle while in its diverted position, and it was curious to see messages sent under these circumstances.

On examining the times when the wires were most strongly charged, it was found that they coincided closely with the outbursts of the auroral displays. These too appear to have reached a maximum about midnight, and a similar maximum about midday as evidenced by the needle disturbances. Atmospheric electricity was, as a rule, more than usually quiescent, while these earth currents were so strong. The passage of the "bright beam" before mentioned was accompanied at Sidmouth by an an unusually strong telegraphic disturbance. A pointsman had false signals conveyed to him; bells were set ringing, and other interruptions to his work experienced. The declination and horizontal needles in our national and other observatories, registered correspondingly considerable movements in both directions.

Nor were these manifestations of auroral and magnetic disturbances local to Great Britain. From America and Sweden, from Rome, Florence, and Spain, came accounts also, though, perhaps, we must receive with caution the report that in America the earth currents were strong and persistent enough to work an electric lamp.

The entire history of this series of auroræ, sunspots, and magnetic disturbances will doubtless, when collected, prove of the highest interest and value. The meteorological conditions pending the auroral period, of course differed according to locality; but speaking generally, the weather may be described as of an unsettled character, with rather low temperature, and with varying sky conditions, auroræ being reported from some places, which, from the presence of clouds, were not seen short distances off.

Some observers report storm clouds and lightning in the early part of the period, while others speak of peculiarly coloured sunsets and so-called magnetic arrangement of clouds. Winds mostly N and W, and of medium force seem to have prevailed and to have been accompanied by varying, but mainly low dew-point, hygrometric conditions. The auroræ passed off with a warmer temperature and air more saturated with moisture, but a still unsettled character of weather, solar and lunar halos (in some cases of abnormal form) being seen. The popular impression that auroræ predict an inclement winter, appears likely to be confirmed by the recent cold wave experienced here and abroad. The large quantity of berries on fruit-bearing shrubs is also by tradition connected with a hard winter—while one observer with more perhaps of reason for his theory, associates the movements of certain insects with such a forecast. Certainly everyone has remarked on the sudden and violent changes of weather conditions which have accompanied and followed our Northern Light period of 1882.

J. R. C.

THE METEOROLOGICAL SOCIETY.

The opening meeting of the session was held on Wednesday evening, the 15th ult., at the Institution of Civil Engineers, Mr. J. K. Laughton, F.R.A.S., president, in the chair.

Eleven new Fellows were elected, viz. :—Rev. J. Brunskill, F. B. Buckland, C. F. Casella, W. H. M. Christie, F.R.S. (*Astronomer Royal*), A. Cresswell, R. S. Culley, C. Morris, O. L. O'Connor, H. Parker, F.Z.S., A. Rowntree, and D. R. Sharpe.

The papers read were :—1. "On Certain Types of British Weather," by the Hon. Ralph Abercromby, F.M.S. The author shows that there is a tendency of the weather all over the temperate zone to occur in spells associated with certain types of pressure-distribution. In Great Britain there are at least four persistent types—the southerly, the westerly, the northerly, and the easterly. In spite of much fluctuation, one or other of these types will often continue for weeks together, and tend to recur at the same date every year. The value of the recognition of type groups is shown in the following ways :—(1). They explain many phenomena of weather, and many popular prognostics. (2). In some cases they enable forecasts to be issued with greater certainty and longer in advance than usual. (3). We can by their means correct statistical results, by giving the real test of identity of recurrent weather, which no single item, such as heat, cold, rain, &c., can do. (4). They enable us to treat such geological questions, as the influence of changing distribution of land and sea on climate, in a more satisfactory manner than can be done by any other mode.

2. "On the use of Kites for Meteorological Observation," by Prof E. Douglas Archibald, M.A., F.M.S. In this paper the autho advocates the use of kites for Meteorological Observations, and

describes the mode in which they may be best flown so as not to be mere toys, but scientific instruments, capable of ascending to great heights, 1000 ft. or more, remaining steady in currents of varying velocity, being manipulated with ease and rapidity by the observer, and carrying instruments of considerable weight.

3. "The Meteorology of Mozufferpore, Tirhoot, 1881," by Charles M. Pearson, F.M.S.

At the close of the meeting, Mr. S. G. Denton, F.M.S., exhibited a set of 46 mercurial thermometers, which were made by him between February and June, 1881; they were all tested at Kew Observatory in June, 1881, were then placed at the observatory under seal, and the case was only opened for their reverification in January 1882 and June 1882, when it was found that scarcely any rise of zero point had taken place. As no paper descriptive of the mode of manufacture was submitted to the Society, we can of course merely state the above somewhat remarkable facts. Until the method adopted is explained, we shall prefer to rely upon age as the most certain mode of escaping serious change of zero, but in cases where a thermometer of special pattern is required to be made and and used within a few months, Mr. Denton's method whatever it may be, appears likely to be very valuable.

GREAT RAINFALL IN THE NORTH EAST OF THE UNITED STATES.

SEPTEMBER 20TH-24TH, 1882.

[OUR readers are probably aware that the average rainfall of New York and over the State of New Jersey is about 40 inches, or much the same as at stations clear of hills on the western coast of the British Isles. With this fact before them they will realise the exceptional character of the above rainfall, the following notes respecting which we extract from No. 9 of the "New Jersey Weather Review," edited by Mr. W. Earle Cass.—ED. *Met. Mag.*]

One of the most memorable rain storms that has ever been recorded in the State of New Jersey, occurred on Sept. 20th to 24th. Beginning on the 20th with light rains which gradually increased, until they reached an amount that has never been equalled in this State, so far as the records show, except in isolated localities. The result of all this downpour was the rising of the various streams, especially in Passaic, Essex, Union, Middlesex and Mercer counties, until they were beyond control, when, breaking all bounds, they carried destruction before them, such as was never known in this State before. Space will not allow of an extended notice of this storm, and as the daily press has furnished far more information in regard to it than can possibly be inserted here, only such matter as is noteworthy to the meteorologist will be given.

Rainfall of September 20th, 21st, 22nd and 23rd, 1882.

	20th.	21st.	22nd.	23rd.	TOTAL.
Port Jervis, N.Y.	...	·09	1·38	2·61	4·08
Newton	·07	·50	2·17	2·855	5·59
White Plains, N.Y.	...	...	..	3·35	...
Delaware, Water Gap. Pa.	...	...	1·45	2.40	3·85
Paterson	...	·95	5·55	11·40	17·90
Caldwell	...	·80	2·38	7·75	10·93
Belvidere	...	·02	2·85	1·95	4·82
South Orange	...	...	3·50	7·50	11·52
Newark, Summer Place..	·13	·35	3·33	7·39	11·20
,, Lombardy St.	...	...	...	8·67	12·60
New York Sig. Office ...	·57	·78	1·49	6·17	9·01
,, ,, Central Park.	...	...	...	...	11·65
Readington	...	·30	4·20	4·50	9·00
Somerville	·35	...	3·34	4·35	8·04
New Brunswick.....	·62	·61	4·12	6·49	11·84
Sandy Hook	·33	·30	2·23	2·14	5·00
Princeton.....	...	·30	2·49	5·69	8·48
Freehold	·48	·32	2·72	3·33	6·85
Fallsington, Pa.....	1·65	·17	2·20	4·94	8·96
Moorestown	...	·51	2·33	4·66	7·50
Philadelphia, Sig. Office..	...	1·72	4·65	3·72	10·09
Barnegat	·82	·19	·40	·94	2·35
Atco	...	...	...	5·45	5·45
Vineland	...	21st to 26th	...	...	6·09
Atlantic City	...	·16	·39	·17	0·72
Cape May	...	·30	·11	·92	1·33

Special Measures of Rain during the Storm.—At New Brunswick, 23rd, 6.30 p.m., 1·10 inch in 30 minutes. Newark, 23rd, 1 p.m., 0·82 inch in 30 minutes, 7 p.m. to 8 p.m. 0·865 inch, 8 p.m. to 9 p.m. 0·95 inch. Newton, 22nd, 2·17 inch in five hours, 23rd, 0·925 inch in 30 minutes. South Orange, 23rd, 9 a.m. to 11 p.m. 7½ in Moorestown, 23rd, 2 p.m. to 8.30 p.m. 3·29 inch. The amount of rain at Paterson and New York Central Park, as shown by Prof. Draper's self-recording rain gauges, was as follows:—

From	To	Hrs.	Min.	New York.	Paterson.
9 p.m. on the 20th...	8 a.m. on the 21st ..	11	...	1·00	·82
9 a.m. ,, ,, 21st...	7 p.m. ,, ,, ,, ...	10	...	...	·08
7 p.m. ,, ,, ,, ...	4 a.m. ,, ,, 22nd..	9	...	·01	·12
4 a.m. ,, ,, 22nd..	8 a.m. ,, ,, ,, ...	4	...	·25	·13
8 a.m. ,, ,, ,, ...	9 a.m. ,, ,, ,, ...	1	...	·05	·78
9 a.m. ,, ,, ,, ...	Noon ,, ,, ,, ...	3	...	·40	2·00
Noon ,, ,, ,, ...	2 p.m. ,. ,, ,. ...	2	. .	...	1·60
2 p.m. ,, ,, ,, ...	5 p.m. ,, ,, ,, ...	3	...	1·62	·92
5 p.m. ,, ,, ,, ...	4 a.m. ,, ,, ,, ...	11	...	...	·05
4 a.m. ,, ,, 23rd...	9 a.m. ,, ,, ,, ...	5	...	·67	·40
9 a.m. ,, ,, ,, ...	10.30 a.m. ,, ,, ,, ...	1	30	...	1·00
10.30 a.m. ,, ,, ,, ...	11 a.m. ., ,, ,, ...	0	30	·27	·30
11 a.m. ,, ,, ,, ...	1 p.m. ,, ,, ,, ...	2	...	...	3·70
1 p.m. ,, ,, ,, ...	Midnight ,, ,, ,, ...	11	...	7·38	6·00
				11·65	17·90

Observers' Remarks.—Paterson, "The above table readily shows why an excess of rain fell here. The rainfall in Paterson was nearly continuous, while in New York there were several periods in which no rain whatever fell. The table shows that during 9½ hours on the 22nd and 23rd, only 0·45 inch fell in New York, whilst in Paterson for the same time and hours 9·08 inches fell. In a few cases the New York rainfall was in excess of the Paterson fall, but not to any large amount." Freehold—"Clouds very dense, p.ms. of 22nd and 23rd so as to require lights in the class rooms at 3 p.m. for some 15 min. No damage by storm of 22nd and 23rd around here, except to one or two small bridges. No damage between Jamesburg and Sea Girt, but plenty on the New York and Long Branch lines." Fallsington, Pa. "No particular damage done in this vicinity except the washing away of towuship bridges." Moorestown.—"The heaviest noted rainfall during 19 years' observations, and most harmful, nearly every mill dam in this vicinity was swept away, bridges were removed, and trains hindered for many hours by wash-outs on the track as never before since construction." South Orange—"The rainfall of the whole period * * * was the largest amount from any storm in 13 years. The tornado and waterspout which passed over this section in August 1875, precipitated 5·40 inches of water, the most of which fell in two hours, and did more damage to roads and bridges than the present storm. Considering the severity of the rain of the 23rd, the damage done in the town and township was very small."

THE OCTOBER FLOOD.

In our last number, under the title of "Remarkable Rainfall," we printed a letter from Dr. Burder, of Clifton, reporting the fall of October 22-23, to which, for persistent downpour, the records of the previous thirty years afforded no complete parallel. We also stated that the discharge of the Avon at Bristol was unprecedented.

We have subsequently been favoured with a note from Messrs. C. Lucy and Nephew, of Stratford-on-Avon, giving the daily rainfall during October as follows:—

		in.				in.				in
Oct.	1	—	.. ...	Oct.	12	0·25	.....	Oct.	23	0·07
,,	2	0·15	.....	,,	13	0·23	.....	,,	24	2·30†
,,	3	—	.....	,,	14	0·05	.....	,,	25	0·02
,,	4	—	.....	,,	15	—	.....	,,	26	—
,,	5	—	.....	,,	16	0·70	.....	,,	27	—
,,	6	—	.....	,,	17	0·50	.....	,,	28	0·40
,,	7	0·12	.....	,,	18	—	.....	,,	29	—
,,	8	—	.....	,,	19	0·18	.....	,,	30	0·05
,,	9	—	.....	,,	20	0·20	.....	,,	31	0·23
,,	10	—	.....	,,	21	0·10	.....			——
,,	11	0·21	.....	,,	22	0·62	.....		Total	6·38

† This 2·30 in. fell in twelve hours.

and the following note :—

"On the 25th October, this year, we registered the highest flood on the Avon here since 1801 ; the water rising to a point two inches higher than in the memorable flood which reached its highest point July 22nd, 1875."

We reprint for comparison, and also as an indication of the class of information which is urgently needed, a paragraph from a paper on "Floods in England and Wales in 1875," read before the Institution of Civil Engineers in 1876.

"At Stratford-on-Avon a flood board was placed by the bank of the river, at the Stratford Flour Mills at the beginning of the present century, and every occasion when the floods have risen to 4 ft. above the weir has been recorded. Messrs. C. Lucy and Nephew, in sending the following list, remark that of a total of ten floods which have exceeded 4 ft. in height, four were in 1875, being the only instance where more than one flood has reached over the 4 ft. in the same year.

			ft	in.
1801	.....	Date unknown	7	2½
1821	.....	December 25th	5	8¼
1848	.....	October 1st	6	4½
1852	.....	November 12th.....	5	10½
1853	.....	July 15th	5	5
1872	.....	December 14th	5	4
1875	.....	July 22nd	6	8
,,	.....	October 12th	4	9
,,	.....	October 21st	6	0½
,,	.....	November 14th	5	9
1882	... ..	October 25th.....	6	10

We have added the recent flood so as to complete the list.

We shall be greatly obliged by any of our readers who can supply lists of flood levels doing so, and by all, who have convenient opportunities, commencing similar records. Accurate details of the highest points reached by floods are of extreme engineering importance.

HALOS AND WEATHER.

To the Editor of the Meteorological Magazine.

SIR,—In accordance with your suggestion in the *Meteorological Magazine* for October, I send you some notes on halos and weather.

Of 122 solar halos observed here from October 1st, 1880, to October 31st, 1882, 73 were followed by rain within 24 hours, and 49 by fine weather, but in 22 cases out of the 49 rain fell within 48 hours. Of 21 lunar halos 12 were followed by rain in 24 hours, 9 by fine weather, with rain in 48 hours in 5 of the 9. The largest number of halos was noted in the month of May. In the present month (November) 6 solar and 4 lunar halos have occurred, and after all of them rain fell within 24 hours.

Yours truly,

E. T. DOWSON.

Geldeston, Beccles, Nov. 22nd, 1882.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JULY, 1882.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Maximum. Date.	Minimum. Temp.	Minimum. Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	TotalRain. Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		
England, London	77·8	30	46·0	1	71·5	53·0	52·0	74	128·8	44·1	2·95	18	6·1
Cape of Good Hope	77·4	15	34·0	14	64·0	46·2	49·6	82	...	...	5·33	12	4·1
Mauritius	75·6	5	60·6	19	73·0	65·5	59·9	73	...	...	2·76	19	6·1
Calcutta	92·5	1	75·9	15	88·3	78·2	78·2	86	160·2	74·0	11·76	28	8·2
Bombay	84·9	29	74·9	27	82·4	76·0	76·1	90	143·3	71·2	26·94	30	9·6
Ceylon	86·3	26	71·8	15	84·0	75·8	72·1	78	152·6	65·0	12·89	19	8·2
Melbourne	64·0	7	33·0	21	54·7	42·1	39·4	74	112·9	27·0	2·25	16	6·1
Adelaide	69·7	6	34·5	17*	56·8	41·9	41·4	74	129·5	27·5	2·12	16	5·8
Wellington	61·0	14	37·0	20	53·4	44·0	...	...	114·0	30·0	8·67	23	...
Auckland	62·0	1	37·6	24	57·3	46·3	46·6	83	...	32·9	9·16	25	6·2
Falkland Isles	46·9	12	23.2	24	40·1	32·1	34·1	92	85·0	20·0	·84	21	7·1
Jamaica	90·8	12†	71·8	7	88·4	73·9	73·2	77	...	65·7	2·03	6	4·1
Barbados	83·0	var.	70·0	8, 11	82·0	73·0	73·6	82	148·0	70·0	5·99	20	6·0
Toronto	89·9	26	51·3	20	76·9	56·9	56·6	70	144·5	46·0	1·06	11	5·5
New Brunswick, S. John	74·0	12‡	44·0	3	66·2	52·6	54·9	85	...	...	4·64	14	6·0
Cape Breton, Sydney	83·9	26	46·0	1	72·9	53·7	55·8	75	...	...	3·68	13	5·6
Newfoundlnd, S. John's	...	...	...	...	...	...	...	...	...	...	...	...	...
Manitoba, Winnipeg	85·7	24	37·5	13	74·7	53·1	56·3	77	149·5	...	6·61	12	4·6

* And 28. † And 26. ‡ And 15.

REMARKS, JULY, 1882.

Mauritius.—Mean temp. and rainfall both a little above average; mean pressure 30·243 in.; mean hourly velocity of wind 13·6 miles; extremes 31·6 miles and 1.9 miles; prevailing direction E.S.E. C. MELDRUM, F.R.S.

Ceylon.—Thunderstorms occurred on 4 days, and T was heard on 2 other days. J. STODDART.

Melbourne.—Mean pressure, temp., humidity, and amount of cloud all about the average; rainfall above it; prevailing wind N., heavy squalls occurring on 5 days; hoar frost on 4 days, and ice on 21st. Snowstorm on 26th over a great portion of S. eastern Australia. L on 3 days; H on 27th; dense fog on 19th. R. L. J. ELLERY.

Adelaide.—Mean pressure (30·145 in.) slightly, mean temp. (49°·3) 2°·5, and rainfall nearly ·50 in. below average. The latter part of the month was very cold, and frost was of frequent occurrence. C. TODD.

Wellington.—Unpleasant, showery, squally weather, almost throughout the month, and only a few fine days. Strong winds on 7 days, prevailing direction, N.W.; T on 2 days, H on 2 days; rainfall on 27th 2·90 in., causing much damage by floods. Mean temp. above, and mean pressure below average. R. B. GORE.

Auckland.—Mean pressure ·2 in., and mean temp. °·8 below average; rainfall nearly double the average; wind mostly W. and S.W. Weather constantly wet and stormy. E. B. DICKSON.

BARBADOS.—Mean pressure slightly below average, mean temp., 76°·7 also slightly below average; prevailing wind N.E., average velocity 12·6 miles, extremes 19 miles and 7 miles. Rainfall 3% below, and evaporation 35% above average. TSS on 3 days. R. BOWIE WALCOTT.

WINNIPEG.—Rainfall 3·97 in. above average, and the largest fall in any month during 10 years, excepting June, 1877, when 7·69 in. fell.

SUPPLEMENTARY TABLE OF RAINFALL, NOVEMBER, 1882.

[For the Counties, Latitudes, and Longitudes of most of these Stations, see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	3·17	XI.	Solva	4·11
,,	Margate, Birchington...	3·19	,,	Castle Malgwyn	6·77
,,	Littlehampton	3·90	,,	Rhayader, Nantgwillt..	11·63
,,	St. Leonards	3·57	,,	Carno, Tybritle	10·92
,,	Hailsham	4·31	,,	Corwen, Rhug	6·37
,,	I. of W., St. Lawrence.	4·02	,,	Port Madoc	7·92
,,	Alton, Ashdell.....	4·23	,,	I. of Man, Douglas	8·29
III.	Great Missenden.....	3·62	XII.	Carsphairn	10·01
,,	Winslow, Addington ...	4·35	,,	Melrose, Abbey Gate...	3·77
,,	Oxford, Magdalen Col...	3·42	XIII.	N. Esk Res. [Penicuick]	4·45
,,	Northampton	3·40	XIV.	Ayr, Cassillis House ..	6·18
,,	Cambridge, Beech Ho...	2·41	,,	Glasgow, Queen's Park.	5·50
IV.	Southend	2·93	XV.	Islay, Gruinart School..	7·41
,,	Harlow, Sheering	3·21	XVI.	St. Andrews, Newton Bk	4·69
,,	Diss	2·96	,,	Aberfeldy H.R.S.	4·55
,,	Swaffham	3·32	,,	Dalnaspidal	7·73
,,	Hindringham	4·24	XVII.	Tomintoul.....	...
V.	Salisbury, Alderbury...	3·65	,,	Keith H.R.S.	4·30
,,	Calne, Compton Bassett	4·30	XVIII.	Forres H.R.S.	2·54
,,	Beaminster Vicarage ...	4·22	,,	Strome Ferry H.R.S....	10·46
,,	Ashburton, Holne Vic..	9·54	,,	Lochbroom	6·66
,,	Torrington, Langtree W.	7·55	,,	Tain, Springfield.....	2·48
,,	Lynmouth, Glenthorne.	8·58	,,	Loch Shiel, Glenaladale	14·51
,,	St. Austell, Cosgarne...	...	XIX.	Lairg H.R.S.	...
,,	Taunton, Fullands	3·61	,,	Forsinard H.R.S.	4·60
VI.	Bristol, Clifton	...	,,	Watten H.R.S.	3·91
,,	Ross	3·82	XX.	Fermoy, Glenville	5·74
,,	Wem, Sansaw Hall.....	3·88	,,	Tralee, Castlemorris ...	6·52
,,	Cheadle, The Heath Ho.	4·93	,,	Cahir, Tubrid	3·99
,,	Worcester, Diglis Lock	3·97	,,	Newcastle West	6·53
,,	Coventry, Coundon	4·05	,,	Kilrush	...
VII.	Melton, Coston	3·57	,,	Corofin	6·70
,,	Ketton Hall [Stamford]	3·38	XXI.	Kilkenny, Butler House	...
,,	Horncastle, Bucknall ...	3·03	,,	Carlow, Browne's Hill..	3·90
VIII.	Macclesfield, The Park	6·18	,,	Navan, Balrath	4·22
,,	Walton-on-the-Hill.....	4·60	,,	Athlone, Twyford	7·12
,,	Broughton-in-Furness ..	9·59	XXII.	Mullingar, Belvedere ...	6·28
IX.	Wakefield, Stanley Vic.	2·92	,,	Clifden, Kylemore	11·90
,,	Ripon, Mickley	4·19	,,	Crossmolina, Enniscoe..	8·71
,,	Scarborough.....	3·86	XXIII.	Carrick-on-Shannon ...	4·57
,,	East Layton [Darlington]	3·37	,,	Dowra	7·49
,,	Middleton, Mickleton ..	6·08	,,	Rockcorry.....	6·27
X.	Haltwhistle, Unthank..	4·86	,,	Warrenpoint	7·80
,,	Carlisle, St. James Rd...	5·31	,,	Newtownards	4·54
,,	Shap, Copy Hill	6·88	,,	Belfast, New Barnsley .	7·64
XI.	Llanfrechfa Grange	6·62	,,	Bushmills	7·48
,,	Llandovery	8·21	,,	Buncrana	7·82

NOVEMBER, 1882.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	2·57	+ ·13	·43	15	18	61·8	5	25·4	18	4	12
II.		Maidstone (Hunton Court)...	3·46	+ ·56	·57	14	22	...	...	...	...	...	...
,,		Strathfield Turgiss	2·77	+ ·02	·52	6,15	20	60·3	5	21·2	18	8	19
III.		Hitchin	3·26	+ ·65	·95	15	23	57·0	5	22·0	17	13	...
,,		Banbury	4·25	+ 1·54	·86	6	23	59·0	5	22·0	18	13	...
IV.		Bury St. Edmunds (Culford)	2·70	— ·13	·42	6	24	60·0	5	24·0	17	9	..
,,		Norwich (Cossey)	3·68	+ ·37	·84	6	21	59·5	5	24·5	18	7	10
V.		Bridport	3·60	...	·68	6	19	...	..	...	...	...	...
,,		Barnstaple.....	7·61	+ 3·46	·89	6	24	61·0	6	28·0	15	...	..
,,		Bodmin	6·10	+ ·78	·70	6	27	56·0	4	29·0	15	2	5
VI.		Cirencester	4·79	+ 1·81	·66	6	20	..	...	...	...	...	...
,,		ChurchStretton(Woolstaston)	5·20	+ 1·76	·63	23	26	57·0	5	29·0	15	10	20
,,		Tenbury (Orleton)	3·99	+ 1·13	·58	6	23	61·5	5	22·0	18	10	17
VII.		Leicester	3·18	...	·57	6	25	58·5	5	22·0	18	7	16
,,		Boston	2·79	+ ·42	·65	6	19	60·0	5	26·0	18	3	...
,,		Grimsby.....	2·96	— ·14	·52	3	24	58·0	5	27·0	18	5	...
,,		Hesley Hall [Tickhill].....	3·08	...	·39	4	23	56·0	4	23·0	18	7	...
VIII.		Manchester (Ardwick).....	6·01	+ 3·04	·69	20	25	56·0	1	29·0	12*a*	0	...
IX.		Wetherby (Ribstone Hall) ..	2·95	+ ·19	·38	4. 26	15	...	...	...	...	...	...
,,		Skipton (Arncliffe)	9·87	+ 4·12	1·32	5	27	54·0	5	22·0	17	...	...
X.		North Shields	2·71	— ·74	·42	18	23	59·5	5	27·2	18	11	11
,,		Borrowdale (Seathwaite).....	18·52	+ 6·70	2·52	3	23	...	...	...	...	..	...
XI.	WALES.	Cardiff (Ely).....	6·01	+ 1·81	·91	6	17	...	...	...	...	...	...
,,		Haverfordwest	6·33	+ ·99	·70	3	20	...	...	25·0	14	5	12
,,		Plinlimmon (Cwmsymlog)...	9·27	...	·82	21	25	...	...	...	...	...	...
,,		Llandudno.....	3·91	·00	·48	5	23	56·1	5	30·2	15	1	...
XII.	SCOTLAND.	Cargen [Dumfries]	5·39	+ 1·48	1·03	3	20	...	...	...	...	...	...
,,		Hawick	3·21	·00	·64	3	22	...	...	..	...	...	...
XIV.		Douglas Castle (Newmains)	6·50	+ 2·95	·98	4	20	...	...	...	...	...	...
XV.		Lochgilphead (Kilmory).....	11·89	+ 6·53	1·15	3	23	...	...	24·0	17	15	...
,,		Appin (Airds)	8·84	...	...	...	...	...	...	...	...	...	.
,,		Mull (Quinish).....	9·35	...	·96	21	26	...	...	...	...	...	...
XVI.		Loch Leven Sluices	4·50	+ ·95	·60	6	17	...	...	...	...	...	...
,,		Arbroath	3·42	+ ·27	·53	5	20	53·0	1	28·0	20	13	...
XVII.		Braemar	5·52	+ 1·75	·89	3	20	48·8	1	16·8	30	21	29
,,		Aberdeen	5·22	...	·88	25	25	53·0	1	26·0	19	11	...
VIII		Skye (Sligachan)	...	...	...	...	...	...	...	...	...	...	...
,,		Culloden	2·20	— ·50	...	...	...	53·2	1	26·8	14*b*	12	26
XIX.		Dunrobin	3·66	...	·50	26	18	52·0	1	27·5	14	13	...
,,		Orkney (Sandwick)..... ..	4·02	— ·42	·68	18	21	51·2	1	30·2	20	5	19
XX.	IRELAND.	Cork (Blackrock)	5·10	+ ·49	1·19	30	23	56·0	5	26·0	13	8	...
,,		Dromore Castle	9·05	...	·95	3	27	56·0	4	31·0	13	...	...
,,		Waterford (Brook Lodge) ...	4·14	...	·88	30	22	57·5	5, 22	29·0	12	6	...
,,		Killaloe	7·63	...	·75	3	22	58·0	2	27·0	12	6	...
XXI.		Portarlington	4·47	+ 2·07	·57	3	25	56·5	5	25·0	11	7	...
,,		Dublin (Monkstown)	...	...	...	...	...	...	...	...	...	...	...
XXII.		Ballinasloe	5·49	...	·64	4,7	26	54·0	1, 5	25·0	12*c*	11	...
XIII.		Waringstown	5·11	+ 2·40	1·13	15	23	57·0	1	23·0	11	13	22
,,		Londonderry...	...	...	...	...	...	...	...	...	...	...	...
,,		Omagh (Edenfel).....	6·85	+ 3·80	·85	15	26	55·0	5	24·0	11	15	...

+ Shows that the fall was above the average; — that it was below it.

a And 18. *b* And 17. *c* And 14.

METEOROLOGICAL NOTES ON NOVEMBER.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—The weather of the month was unsettled and changeable; very wet without very much R; the country was much flooded, and the sodden state of the land will probably bring again the fluke in sheep. Primroses in flower on 5th; swallow seen on 18th.

HITCHEN.—On the 15th the heaviest fall of S since January 1881.

BANBURY.—Mean temp. 41°·6; mean pressure low, but weather generally fine when it was lowest. S on 16th 3½ in. deep, and much more in the country; floods frequent; high wind almost daily till 14th; L frequent at night during first part of month. Remarkbly fine rosy aurora on 17th.

CULFORD.—High winds, continual wet, and frequent frosts caused the leaves to fall early; root crops exceedingly good.

COSSEY.—Brilliant aurora on 17th; solar halo on 21st; L all the evening of 8th.

BODMIN.—The singular characteristic of the month was that the most unfavourable weather nearly always followed a rising bar. and that the lowest bar. was attended by better weather. Mean temp. 45°·0.

CIRENCESTER.—A mild month with considerable rainfall; land so wet that wheat could not be planted.

WOOLSTASTON.—A month of incessant R; mean temp. 41°·0; T and L with H on morning of 4th, and again with very violent H on 8th from 9.30 to 10.30 p.m. A remarkable display of aurora in the early morning of 18th. S on 15th.

ORLETON.—The first six days were warm with R daily and rough wind; on the night of 6th a heavy fall of R occurred, and the remainder of the month was generally cold and rainy with occasional sunshine and strong gales of wind. A fall of S occurred on 15th, covering the ground to a depth of from three to six inches. Very little wheat planted owing to the wetness of the land. Mean temp. 1°·5 above the average of 20 years; bar. low and very unsteady, with frequent changes of wind. Auroræ on 17th and 27th.

KILLINGHOLME.—Weather very unsettled, and farm work at a standstill, owing to the almost daily R.

SEATHWAITE.—H and T frequent during the month; eight falls of R exceeding 1 in. in 24 hours. Gale on 5th; aurora on 17th.

WALES.

LLANDUDNO.—A showery and unusually dull month, the total duration of bright sunshine being only 31·7 hours. Mean temp. about 0°·8 below the average, but frost occurred on one night only; electrical and atmospheric storms were frequent. S on distant hills from 8th to end of month.

SCOTLAND.

CARGEN.—A dull, stormy month. Duration of sunshine 72 hours, 22 hours below average; T and L frequent during first part of month; auroræ on 13th and 17th.

HAWICK.—A month of very variable weather; magnificent aurora on 17th.

BRAEMAR.—A very unsettled month, frequent heavy storms with R and S. Auroræ on 13th and 20th.

ABERDEEN.—The weather was rainy and unsettled throughout the month, and the total rainfall is about two inches above the average; L on 20th; auroræ on 13th, 17th, and 18th; from 17th to 19th telegraphic communication was interrupted by powerful earth currents.

CULLODEN.—The weather during the month was favourable for field labour, the period from 11th to 22nd being very fine; moderate frosts at night very general all through the month.

SANDWICK.—November was damp and calm, and the ground was so wet as to put a stop to ploughing, but this must have been owing to a want of evaporation during the calm weather rather than to the fall of R, which was not great. The month was remarkable for frequent displays of aurora (seen on 10 nights), those on 12th, 13th, and 20th having been particularly brilliant, and that on

17th a fiery red colour; gales of 50 miles an hour for two hours on 4th, and three hours on 18th.

IRELAND.

DROMORE.—The month was incessantly rainy, but not generally cold; on the evening of the 22nd, a lunar rainbow was seen.

WATERFORD.—Rainfall above the average; prevailing winds S.W. and N.W. Gales on 3rd, 4th, and 19th; L on 7th; T and H on 8th; solar halo on 13th.

KILLALOE.—A very wintry month, unusually wet and stormy; L and T on 3rd.

BALLINASLOE.—The month was generally very squally and wet, with L and T in the early part; very high floods all over the country, and much damage to the potato crop.

WARINGSTOWN.—A very wet and gloomy month; the wettest November during 21 years; brilliant auroræ on 13th and 17th.

EDENFEL.—An extremely wet, cold, and inclement month; owing to the failure of the potato and the scarcity of turf (from the wet summer) there is much privation and suffering amongst the poor.

HALOS AND WEATHER.

To the Editor of the Meteorological Magazine.

SIR,—In reply to the note in your October number, page 140, I give my experience.

The average number of days on which there are solar halos here, according to my observations from 1866 to 1879, is 76, and the average number of nights on which there are lunar halos is 25. In nearly all cases there was the ordinary halo of about 23° radius, as it seldom happens that there is any other kind of halo without this also being seen. Halos are common in very fine, even in settled fine, weather. When a covering of cirrus gradually overspreads the sky and grows thicker and thicker, as a rule it is a sign of the advance of a barometric depression, nearly always accompanied by more or less rain. In these cases a halo is usually seen upon the cirrus; but sometimes there is no halo, or at least it has escaped my observation. I am not aware, however, that on these occasions the rain is less likely to follow than when the halo is present. I am of the opinion that when halos are very striking, or when they are of any other kind than the ordinary one, or when there are mock-suns, rain usually follows; but not having kept account of the occasions when this occurs, I am merely giving my impression. Some of the most remarkable halos occur on the fringes of thunder-clouds or snow-clouds, and on these occasions there is usually, perhaps always, a shower; but it may not occur in the precise locality whence the halo was observed.

I have not noticed any other circumstances in which halos are directly connected with rain or snow; and bright halos undoubtedly occur without any rain following.

The number of halos per year, as mentioned above, is considerably greater than any of the numbers given in your note; it seems probable, therefore, that I have taken account of fainter halos or of more fleeting ones than the observers there named.—Yours truly,

THOS. WM. BACKHOUSE.

Sunderland, 28th Nov., 1882.